WE CLAIM AS OUR INVENTION:

1. A time-variable magnetic fields generator for a magnetic resonance apparatus comprising:

a gradient coil formed by conductors adapted to be disposed at a subject-receiving, hollow opening of a magnetic resonance apparatus, said hollow opening having an axial extent and said gradient coil being free of said conductors at an axial middle region of said hollow opening;

a radio-frequency antenna element for emitting a radio-frequency field, adapted to be disposed in said middle region;

a first radio-frequency shield enclosing said conductors at a first side of said middle region;

a second radio-frequency shield enclosing said conductors at a second, opposite side of said middle region;

a third radio-frequency shield proceeding radially around an exterior of said radio-frequency antenna element; and

said first, second and third radio-frequency shields delimiting a field return space for return of said radio-frequency field.

2. A generator as claimed in claim 1 wherein said gradient coil is adapted to be disposed at a subject-receiving hollow opening wherein said middle region is cylindrical.

3. A generator as claimed in claim 2 wherein said radio-frequency antenna element is adapted to extend into said hollow opening.

4. A generator as claimed in claim 1 wherein said gradient coil is adapted to be disposed at a subject-receiving hollow opening wherein said middle region is barrel-shaped.

5. A generator as claimed in claim 1 wherein said radio-frequency antenna element connects said first and second radio-frequency shields together in terms of radio-frequency, and wherein said first and second radio-frequency shields in combination with said radio-frequency antenna element form a radio-frequency antenna.

6. A generator as claimed in claim 5 wherein said first and second radio-frequency shields and said radio-frequency antenna elements form a birdcage antenna, as said radio-frequency antenna.

7. A generator as claimed in claim 5 wherein said first and second radio-frequency shields and said radio-frequency antenna elements form an array antenna, as said radio-frequency antenna.

8. A generator as claimed in claim 1 comprising a connection connecting each of said first and second radio-frequency shields with said third radio-frequency shield, said connection also forming a radio-frequency shield, for causing said first, second and third radio-frequency shields and said connection to shield said return space from radio-frequency up to said middle region.

9. A generator as claimed in claim 1 wherein said first, second and third radio-frequency shields in combination with said radio-frequency antenna element form a radio-frequency antenna in which said third radio-frequency shield is a return conductor.

10. A generator as claimed in claim 1 wherein said gradient coil generates a gradient field, and wherein at least one of said first, second and third radio-frequency shields is permeable for said gradient field and is substantially impermeable for said radio-frequency field.

11. A generator as claimed in claim 1 comprising a gradient shielding coil associated with said gradient coil.

12. A generator as claimed in claim 11 wherein said gradient shielding coil is outwardly radially spaced from said gradient coil, and wherein said third radio-frequency shield is disposed between said gradient shielding coil and said gradient coil.

13. A generator as claimed in claim 12 wherein said gradient coil, said first and second radio-frequency shields and said radio-frequency antenna element comprise a unitary structural component.

14. A generator as claimed in claim 1 wherein said gradient coil system is comprised of two halves, and wherein said radio-frequency antenna element is disposed between said two halves.

15. A magnetic resonance apparatus comprising:

a housing containing a hollow opening adapted to receive an examination subject therein, at least partially surrounded by a basic field magnet for generating a basic magnetic field in an imaging volume within said hollow opening; and

a time-variable magnetic fields generator comprising a gradient coil formed by conductors adapted to be disposed at said hollow opening of a magnetic resonance apparatus, said hollow opening having an axial extent and said gradient coil being free of said conductors at an axial middle region of said hollow opening, a radio-frequency antenna element for emitting a radio-frequency field, adapted to be disposed in said middle region, a first radio-frequency shield enclosing said conductors at a first side of said middle region, a second radio-

frequency shield enclosing said conductors at a second, opposite side of said middle region, a third radio-frequency shield proceeding radially around an exterior of said radio-frequency antenna element, and said first, second and third radio-frequency shields delimiting a field return space for return of said radio-frequency field.

16. A magnetic resonance apparatus as claimed in claim 15 wherein said conductors of said gradient coil are adapted to carry a time-varying current for generating a gradient field, and wherein said housing contains elements that interact with said gradient field and generate an eddy current, with an associated eddy current field, said eddy current field causing said gradient field to have a non-linear portion in said imaging volume, and wherein said magnetic resonance apparatus comprises an electrically conductive structure in said housing at least partially surrounding said gradient coil for, triggered by a change in said current carried by said conductors of said gradient coil, generates a compensating eddy current field in said imaging volume for compensating said non-linear portion.

17. A magnetic resonance apparatus as claimed in claim 16 wherein said gradient coil and said electrically conductive structure are tuned to each other for causing said electrically conductive structure to generate a compensating eddy current field that is geometrically similar to said gradient field.

18. A magnetic resonance apparatus as claimed in claim 16 wherein said electrically conductive structure is a portion of said basic field magnet.

19. A magnetic resonance apparatus as claimed in claim 18 wherein said basic field magnet comprises a vacuum vessel, and wherein said vacuum vessel is said electrically conductive structure.

20. A magnetic resonance apparatus as claimed in claim 16 wherein said electrically conductive structure is barrel-shaped.